

Canada. Atomic Energy, Special Committee
on the operation of the Government in the
Field of, 1952/53
(HOUSE OF COMMONS)

Seventh Session—Twenty-first Parliament
1952-53

SPECIAL COMMITTEE

on the

Operations of the Government

in the field of

ATOMIC ENERGY

Chairman: G. J. McILRAITH, Esq.

MINUTES OF PROCEEDINGS AND EVIDENCE *& Reports*

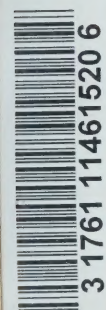
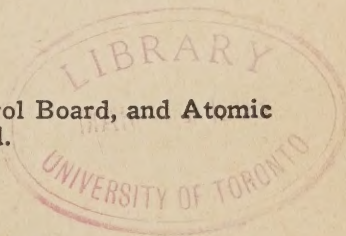
No. 2


MONDAY, MARCH 9, 1953

WITNESS:

Dr. C. J. Mackenzie, President, Atomic Energy Control Board, and Atomic
Energy of Canada, Limited.

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MINUTES OF PROCEEDINGS

MONDAY, March 9, 1953.

The Special Committee appointed to examine into the operations of the Government in the field of Atomic Energy met at 11.00 a.m. The Chairman, Mr. G. J. McIlraith, presided.

Members present: Messrs. Bourget, Coldwell, Gibson, Green, Kirk (*Digby-Yarmouth*), Low, McIlraith, and Murray (*Oxford*). (8).

In attendance: Dr. C. J. Mackenzie, President, and Mr. G. M. Jarvis, Legal Adviser and Secretary, both of Atomic Energy Control Board and Atomic Energy of Canada Limited.

Dr. Mackenzie was questioned by the Committee on the evidence given at the preceding meeting held on March 4.

The Committee agreed that witnesses be called from Eldorado Mining and Refining Limited and from the Department of Mines and Technical Surveys to give evidence at a later meeting.

At 12.50 p.m., the Committee adjourned to meet again at the call of the Chair following its inspection visit to Chalk River.

A. Small,
Clerk of the Committee.

EVIDENCE

MONDAY, March 9, 1953
11.00 a.m.

The CHAIRMAN: Gentlemen, I see a quorum. We have Dr. Mackenzie with us today to answer questions with respect to the briefs which were given in evidence at the last meeting. I now call on Dr. Mackenzie.

Dr. C. J. Mackenzie, President, Atomic Energy Control Board, President, Atomic Energy of Canada Limited, called:

The CHAIRMAN: Dr. Mackenzie, is there anything you want to say?

The WITNESS: No, I do not think there is anything.

By Mr. Kirk:

Q. Dr. Mackenzie, may I pass on a question which was passed to me. It referred to reports which appeared in American newspapers and magazines and which seemed to indicate that private industry in the United States was spending money in the field of atomic energy—with or without the approval of the American government, I do not know—and the question was, if this is the case, would you anticipate that such a movement would in any way affect the program for the development of atomic energy upon which we have embarked in this country?—A. I do not think it would have any effect at all.

Q. Do you think there is anything in these rumours?—A. Yes. This is the situation: Up until, let us say, two years ago, the operation of reactors had for its object the production of fissile material for the bombs, run entirely by the government. The management of certain of the production plants had been under certain companies the research was always done by the government direct. The use of isotopes, and the equipment and instruments for their utilization was done by private industry.

The government supplied the isotopes and let whoever was to use them, use them. Mining activity was always done by private companies; and the manufacture of instruments was done largely by private companies. That left the reactor field entirely in the hands of the government.

But about a year and a half ago it seemed to everyone, I think, in all countries, that the possibilities of employing nuclear power which involved the use of reactors were probably closer than we had thought. At that time, in all countries, people began to think of how you might develop that power if and when it came; and it seemed apparent, without any decision being taken that I know of, that the people who should be interested in power are the people who are experienced in the operation of power plants, whether it be private industry, public controlled industry, or what not.

As far as scientific and technical study are concerned, they felt that the people who must come into the picture are the people who are interested and experienced in power matters. And in the United States, of their own initiative, four groups of companies were set up, or rather set themselves up, and the commission agreed to put information at their disposal so that they could study the feasibility of building commercial power reactors.

These four groups have been set up. They have reported. The reports I do not think are public in their entirety, although there have been many releases of a general nature; and as far as I know they are still studying the feasibility of some program whereby they could, in cooperation with the gov-

ernment or alone, or in some other way, obtain the necessary funds to build prototype power plants. So that is the picture, and I cannot see that it effects our program at all.

We are looking forward to power, and I think we feel the same way, that we must bring into the picture those organizations which are experienced in the production of power; and that would depend on who did it, and it would depend upon the set-up of the country. I think that is the feeling in Britain, in the United States and here. Does that answer your question?

Q. That is very nice. When we go to Chalk River we will go into this power development project more fully, I take it?—A. Yes.

Q. I am greatly interested in the power problem since I come from the Maritimes.—A. I see.

By Mr. Green:

Q. What use could be made of atomic energy for power? For example, could it be taken to the Maritimes or to any other part of Canada where there was a lack of hydro power and used there for the production of electric power?—A. Yes. That, I think, constitutes its great advantage, that it can be located in places where it would not be feasible to locate hydro power or perhaps steam plants. You see, the fundamental thing is this: You have in fissile material a situation where one pound of fissile material is the equivalent of 1200 to 1500 tons of coal in its heat value. Therefore, in very distant plants, where there would be no hydro facilities and where freight rates on coal would be prohibitive, it might very well be that atomic energy would become very advantageous. I think that is the answer.

Q. Could it be exported, for example?—A. Oh, yes.

Q. Could we export atomic energy for power purposes, let us say, to India or to Pakistan?—A. Yes, yes. And we could export fissile material.

By Mr. Low:

Q. You have used the term "fissile"?—A. Yes.

Q. I have heard the term "fissionable" used too. What is the difference?—A. They are exactly the same thing. The discovery was called "fission", as you will recall.

Q. Yes.—A. When an atom of uranium 245 is hit by a neutron, it breaks in two, with a great deal of energy being given off.

Q. Yes.—A. And that phenomenon was called "fission"; so that the words "fissionable", or fissile" material are synonymous.

By Mr. Coldwell:

Q. From your reply to Mr. Green I take it that where there is ample hydro power, or where coal can be used economically, that this fissile material could not be used advantageously? Is that what I take from your reply?—A. You ask if it is economic?

Q. Yes.—A. Mind you, we are just in the period when we are studying these things and one cannot speak with authority. But I think that the best opinion today would feel that atomic energy is not going to compete economically with central station power of the hydro type or the coal type, where coal is cheaper; and that it will be probably faced with its greatest use in an area of power scarcity, or to implement these other sources when they run low.

As you know, the world picture today is very serious; the world demand for power, speaking world-wide, is going up at a terrific rate, and known sources are diminishing. Therefore within not too long a period of time a scarcity of power, from a world point of view, is going to occur.

Q. And you think this would be supplementary to those sources of power?

—A. That is my opinion.

Q. You say that is your opinion?—A. Yes.

By Mr. Low:

Q. Are you speaking, Dr. Mackenzie, from presently known sources of fissile material? You are speaking of plutonium, I suppose?—A. Yes.

Q. And if research work in the next several years should reveal some other substance that was fissionable or fissile, you might change your mind later?—A. I would not change my mind on the proposition that atomic energy will be an important thing to supplement the world supplies of power.

Q. I see.—A. Coal, oil, and hydro are fairly well known as being not unlimited, and if the world demand for power continues as it is at the present time, it will mean that there must be a supplementary source of power provided. If, according to your question, other means besides uranium should be obtainable, that would merely add to our resources of potential energy.

Q. But it would not change materially the economics of the picture?—A. One has to hesitate about prophesying economics because history has shown pretty definitely that the rates go down as development goes up. For instance, aluminum at one time was an impossibly expensive material until development came along and now it is something wonderful.

Q. That is what I had in mind in asking my question.

By Mr. Gibson:

Q. Are we short of any necessary material to convert uranium power into the present type? I was thinking of mercury, or vapour, or whatever you are thinking of. Do we seem to have ample resources of it?—A. Yes.

Q. I was wondering if there was any other critical material of which we would run short?—A. The economic aspect is one of developing a satisfactory material. There are technical and scientific problems yet and until we can say what we want, we cannot say whether it is short or not; but it is one of the points on which there has been a lot of scientific and technical work done.

By Mr. Green:

Q. In what parts of Canada would you say that atomic energy would be most useful for power development?—A. I could not say that.

Q. Would it be, for example, in the Maritimes or in Newfoundland?—A. As a matter of fact, I am not well enough informed on the power situation in the various parts of Canada to say. I have never made a study of it. But I would say that it would be useful wherever there was a scarcity of power or wherever there were high areas, areas where the rates were very high.

My own feeling is—and it is purely a personal matter—that atomic energy will develop probably something in the way that internal combustion power developed and that it will open up new areas. The internal combustion engine in its infancy was thought of as a substitute for coal, but it never was. It opened up the whole field of automobiles, and aircraft, and changed the whole complexion of the world. I cannot document this opinion, but I think there is a general feeling that when we get into a new form of energy, it is likely to be used in areas where there are special requirements or special advantages. It is the sort of thing I feel that we must just take on faith. I think that is a sounder way to take it than to try to document it when you do not know the actual answer.

By Mr. Gibson:

Q. Have we had any luck in getting down from the size of the critical mass? Have we made progress in that direction, so that we might not have the whole world blown up in one explosion?—A. I do not think there is much danger of blowing up the world from one reactor.

Q. Have we got it down smaller than it was originally?—A. There are various types of reactors. You may use a reactor with raw material, or use a reactor with pure fissile material. The reactor for pure material becomes very much smaller in physical terms, but not smaller with respect to the use of fissile material.

In natural uranium, there is only one fissile atom of 140, and if you just take that one atom out and you have a body either of metal or in solution in which you only have fissile material, then the bulk of it becomes very much smaller for the same amount of power.

Q. But you still have to have an immense explosion before you can make it pure?—A. You never get what I think of as an explosion at all. If you just take that one fissile atom out and have a body either metal or solution in which you only have the fissile material, then the bulk of that becomes very much smaller for the same amount of power.

Q. But you still have to have a monster explosion before you can make it possible?—A. You never get what I would think of as an explosion at all.

Q. I was wondering if we can develop anything that would make the atomic explosion smaller?—A. That is a difficult question to answer because we refuse to think of a reactor as an explosion. The concept of explosion is tied up with the time so that the liberation of energy which takes place from material in say five minutes is just ordinary combustion. If you put that in the thousands of millionths of a second it is so rapid that it has the effect of what we would call an explosion but in reactors we do not get to that point.

Q. We are developing artillery shells now for instance. They will not make an explosion the size of the Hiroshima bomb?—A. I know nothing about that.

Q. Perhaps I am on the wrong track.

The CHAIRMAN: We are getting into the whole subject of power and that subject was indicated for examination at Chalk River. Perhaps we would be better to go on with examination of the evidence given the first day and revert to this evidence with respect to power after the brief is given at Chalk River.

Mr. GREEN: There is some information in Dr. Mackenzie's statement made the other day.

The CHAIRMAN: It occurred to me it would be better to reserve our examination on the subject of power until we have had the whole evidence given on the subject as proposed at the meeting at Chalk River. I do not want to cut off the discussion but it seems to me it would be a more orderly method of proceeding.

By Mr. Low:

Q. There was one line of thought I had. That is, when we were at Chalk River the last time, the scientists told us one of the problems they faced was to find some material for building the power developing reactors that would withstand the terrific heat that would be generated, and I think they indicated at the time they were carrying their research into the field of ceramics, and I was wondering if Dr. Mackenzie had something to say about the results of their research in that field?—A. I think generally speaking one can say the researches over the last three years have led the scientists to be more hopeful about the possibilities of obtaining material, but to say specifically what the materials are going to be at the moment is not possible.

The CHAIRMAN: I am wondering if we can go through the evidence page by page.

By Mr. Coldwell:

Q. I was going to skip the history and ask a question. "The Board considered that if it were to supervise properly a program having so many ramifications it should not become too enmeshed in operating details." Then you go on to say: "It would be more efficient and more economic to make use wherever possible of the experience and facilities of other organizations." I was going to ask what cooperation there is now among the three countries, the United Kingdom, the United States and Canada which would enable us to carry out this particular subject. Is there any closer understanding with the United States, for example?—A. May I just make one preliminary observation? We were referring to the cooperation within the Canadian picture. We were thinking of cooperation with the Department of Mines and Technical Surveys, the Geological Survey, and Eldorado Mining and Refining Company which does the mining internally.

Mr. GREEN: The other reference is on page 7.

The WITNESS: Externally the situation is not very different from what it was in 1949. Our exchange with Great Britain is very free and very useful. The cooperation we get from the United States is as free as they can give it under the McMahon Act. I think that we do get a great deal of use out of it but not as much as if there were no McMahon Act.

Q. There has been no freeing of information since 1949?—A. There was one amendment to the McMahon Act which was very limited and has not been very useful. The amendment was in effect that if it could be proven that there was a field in which it would be of mutual advantage—may I amend that—that it was of primary use to the United States defence projects, there could be exchanges with certain restrictions. It had to go before a number of bodies in the United States. It looked as if it might be of value, but practically it has not affected our project at all.

Q. Is Canada making application to the United States for any freeing of this information?—A. I do not know whether Canada has officially. It is a matter which is being attacked all the time unofficially, but I think in Britain they have attacked it officially. I think the situation is this, that the Americans are very much aware of the fact that both the Canadians and the British would like to have more cooperation. I do not think that the lack of cooperation is due to the fact that the Americans do not know we want it.

Mr. Low: The Americans still maintain a liaison officer at Chalk River?

The WITNESS: Yes.

By Mr. Green:

Q. Are any other nations in the same position as the United Kingdom and Canada in so far as obtaining information from the United States is concerned?—A. As to their desire to get it, I think all the countries would be interested in getting it, but very few countries have progressed as far as we have in the field; but it is a matter on which many countries are becoming very interested and they naturally would like the information and I think it is fair to say that there is a continuous declassification going on; every year other information is declassified. It is done within the framework of the McMahon Act. Nearly all of the information on the very low power reactors is declassified so that if any country in the world wishes to build a small zero energy pile it will be possible for them to get information from us and the Americans, and that of course is a step. In connection with the reactors of the NRX class, there is quite a lot of material that is declassified, but when it comes to large production reactors any material that affects the knowledge of the production of fissile material or weapons is very rigidly classified.

Q. By the United States?—A. Yes.

Q. There is the position then, that Canada and the United Kingdom have a very free interchange of information?—A. Yes.

Q. And that the United States has a much freer exchange of information with Canada and the United Kingdom than she has with any other nations?—A. I would not like to say just exactly that, because the restriction of the McMahon Act does not single out the United Kingdom and Canada. I think it is true that we have more interchange of personnel and information. We are in better position to take advantage of the unclassified material, but I think legally one could not state that we occupy that position.

By Mr. Low:

Q. Doctor, does the United States stay with the carbon reactor?—A. They are building very large heavy water reactors at Savannah at the cost of \$1,400,000,000 and they are building another reactor of the size of NRX in Chicago and the United Kingdom is proposing to build an NRX type of reactor just for experimental purposes. So we will not be the only one in the world.

By Mr. Coldwell:

Q. Are all three countries working along the same lines?—A. The United States is generally speaking covering a very broad comprehensive field and in England they are, as you know, building weapons. I would say that the research program at Harwell in England and the research program in Canada generally cover the same field. In both cases, naturally our fields are narrow because there are so many problems that with our limited facilities it is impossible to embark upon all these various types of reactors that might be developed.

By Mr. Green:

Q. Are any other countries except the United States, Great Britain and Canada very far developed with their atomic energy programs?—A. France has two reactors. There is a reactor in Norway which is a combined project with Holland. Sweden is about to start its first reactor, but has not done so. In many other countries there is a great deal of discussing and preliminary planning going on—in India and South Africa. I do not know, of course, anything about behind the Iron Curtain. And Australia is interested, but there are a number of countries which are doing preliminary work, and as you know there is a European project for a nuclear centre which will be located in Geneva. It is rather an interesting experiment and nearly all the European countries are in it because of the fact that no one European country thought it could undertake the very large expenditures. They are putting up an institute in Switzerland to which all these countries will send their scientists, but it is on accelerators at the moment. They are not contemplating building reactors.

By Mr. Coldwell:

Q. What about South American, Argentina?—A. Argentina had a delegation in North America last year. The delegation was here and I see from the press they are getting certain equipment from the United States, not a reactor, possibly cyclotrons in order to study nuclear fission and it seems a very wise way to approach it.

Mr. GREEN: The United States, Canada and the United Kingdom are far ahead of the others?

The WITNESS: Very much so.

Mr. COLDWELL: You know nothing about the Soviet Union at all?

The WITNESS: No.

By Mr. Low:

Q. Consolidated Mining & Smelting Company is the main supply of heavy water?—A. We are not in a position to say that. That in the United States is classified information. Certainly it is the only one in Canada.

The CHAIRMAN: Are there any more questions about "operation of the Board". What about the "raw materials Program"—page 2.

By Mr. Coldwell:

Q. To what extent is Canada a source of raw materials in comparison with the Commonwealth and other places?—A. That again is information which is top secret, but I have seen comment in the press and I think it is common knowledge that Canada will be a very substantial though not the main source.

Mr. COLDWELL: I will not pursue that. I was going to ask another question.

By Mr. Low:

Q. What concentration of ore is considered necessary before an ore body is considered economic to work?—A. I would not like to answer that question. I may say, if the committee is interested in the details, that they might hear from Mr. Bennett of the Eldorado Company, because that is an economic matter.

The CHAIRMAN: We will hear from Mr. Bennett on the whole subject of the operation of Eldorado, and the raw materials price program, but the only point here is the question of policy with relation to the Atomic Energy Control Board.

By Mr. Green:

Q. The policy at the present time is that the Board merely guarantees a price for the ore and the purchase of the uranium that is produced, is that correct?—A. It is not quite that. The Board's responsibilities are very general in character. The Board, I think you could say—the fundamental responsibility that the Board has is to see that the flow of this prescribed material goes in the proper way having regard to the security and health of the people. It has no responsibility for development. As you know, historically, the situation developed in Canada something like this. Eldorado was taken over by the government when the matter developed rapidly in the United States and it became wise to do so and they were the only mining company. Now, the Board would give permission for Eldorado to dispose of these materials in a way that was satisfactory to the government. Then when it came to a matter of other people getting it there had to be some funneling of the negotiations and I think that was probably a government decision rather than the Board's decision entered into with the commission that the most effective way would be for the Eldorado to become the purchasing agent for all the other companies and as there is only one purchaser, that is, the United States, the United States I fancy would prefer that, and so the Eldorado was set up by the government, not by the Board, as the purchasing agent, and the price, as I understand it, is a matter for negotiation. It has nothing to do with the Board or even Eldorado. There would be negotiations with the purchaser on what he would pay. The government would then guarantee to purchase for a period of time so that it would be an internal Canadian arrangement with the individual companies.

Q. Then the only market for uranium ore in Canada is the Eldorado Company?—A. The Eldorado is the only agency; I mean, that a man with a mine producing uranium ore cannot sell to anyone other than the Eldorado?—A. Yes, I think that is true; but I do not think anybody else would buy it.

Q. Then the eventual purchaser from the Eldorado Mining Company is the U.S. government?—A. That is correct—the Atomic Energy Commission.

By Mr. Bourget:

Q. Is the Eldorado selling outside Canada?—A. Just to the Atomic Energy Commission in the United States.

Q. That is the only country we are dealing with?—A. Yes. I think one might modify that statement. There is a very small amount of uranium oxide which they have for a number of years sold to the chemical industry which is insignificant in amount. I think that is true that some was being used for gas mantles and some paints. It is however insignificant.

(Discussion continued off the record).

By Mr. Green:

Q. Apparently there is plenty of incentive to prospectors and mining companies to go out and look for uranium under the present plans?—A. That is apparently so, it has developed very rapidly.

The CHAIRMAN: I presume the committee is interested in this whole matter of price for the concentrates from the mines and so on. It is quite involved and I think the one to give that evidence would be Mr. Bennett.

The WITNESS: I think Mr. Bennett would be very willing.

By Mr. Green:

Q. On this paragraph on page 2:

On the advice of the Board the Government offered to purchase acceptable uranium ores and concentrates at guaranteed minimum prices for a number of years, the latest extension of the guarantee period being to 1962.

Q. Is that on the basis of a guaranteed price offered by the United States for that length of time?—A. It is a matter of negotiation. The government would find out what United States feeling would be. The government feel they have to give these companies some guarantee perhaps beyond the years the Americans would guarantee.

Mr. GREEN: There is a guarantee for a period of nine years from the present time.

The CHAIRMAN: It was ten years from the date of announcement, which was 1952, and the change in the date of guaranteed prices was to April, 1962.

Mr. COLDWELL: That is the minimum price. It may go higher.

The CHAIRMAN: Yes, but it involves an undertaking to take concentrates that minimum price.

By Mr. Green:

Q. Are you in a position to say the length of time for which the United States government has given a guarantee?—A. I do not know that. I am not familiar with any of the negotiations between the Atomic Energy Commission and Eldorado.

Mr. COLDWELL: It is a question for Mr. Bennett.

By Mr. Green:

Q. Is the government doing any actual exploration work itself?—A. Well the Eldorado company is a Crown company and I presume they are doing something. Apart from that I do not think the government has any interest.

The CHAIRMAN: "Eldorado Mining and Refining Company". I presume there are no questions on that unless in relation to the Atomic Energy Control Board.

"Department of Mines and Technical Surveys". In relation to their activities are there any questions you want to ask Dr. Mackenzie about that subject.

By Mr. Green:

Q. The Department of Mines and Technical Surveys seems to be filling quite an important need in this whole programme?—A. I would certainly endorse that. I would like to pay my tribute to the work they have done. It is very important work—the geological survey, receiving reports and integrating the work. They do a terrific amount of assaying and examination. For instance, in 1952-53 the Geological Survey and the Mines Branch—have examined a total of 11,700 samples. They are operating very effectively. That department always has been in the mining field, and in addition in the metallurgical area they are assisting us in Chalk River. It has nothing to do with mining but has a great deal to do with materials that go into the pile and we have found the cooperation excellent.

Q. They have representatives at Chalk River?—A. Yes.

By Mr. Coldwell:

Q. They do field work in making geological surveys of various ores and prospectors go in afterwards?—A. Yes.

By Mr. Green:

Q. Had they anything to do with finding deposits in northern Saskatchewan?—A. I do not know just how they work in the Geological Survey, but there is very close cooperation. Prospectors and mining people receive reports from the Geological Survey. As I understand it, the Geological Survey takes a very comprehensive view of the broad geological formations and are in a position to give some advice as to what would be a promising area, but I do not think they go into prospecting.

Q. Did they play any part in the discovery of uranium ore in northern Saskatchewan, at Beaverlodge?

The CHAIRMAN: How can you tell how much part they played in any discovery in mining in Canada. All prospectors use the data compiled by the Geological Survey Branch.

Mr. COLDWELL: They actually do not do prospecting.

The CHAIRMAN: No, not as I understand it.

Could I ask the committee if it is their wish to have a witness from that department here at a later stage of proceedings?

Mr. Low: I think he could come at the time Mr. Bennett comes.

The CHAIRMAN: I should think he might follow after Mr. Bennett's evidence.

Mr. Low: I was just thinking we might not want to give over a whole meeting to each.

The CHAIRMAN: I could have him here at the same time. I am rather inclined to think when you get into it, it probably will turn out that there is quite a bit of evidence there. If it is your wish then I will make arrangements. I have not made arrangements yet.

Mr. COLDWELL: It is a good idea.

The CHAIRMAN: It completes the information and it is quite important.

Mr. Low: I would certainly like him to come.

The CHAIRMAN: Now, the "Chalk River Project".

By Mr. Green:

Q. Dr. Mackenzie, has the fact that the main reactor is no longer functioning in Chalk River given you any difficulty in holding your staff?—A. No, we have so much work and so very much interesting work that we can hardly find the men to do the work. The repairs and the work of putting the reactor back is quite a fascinating challenge and everybody is working very hard, and I would say that 90 per cent of the people are working very, very vigorously on the component parts.

By Mr. Coldwell:

Q. I was going to say at the present time you have no difficulty in holding your staff.—A. I do not think so. We can get you the information on that. These days there is a shortage of staff everywhere in all companies. We know that. But I just looked over the list of our top scientific people who were present in 1949 and then noted the ones who have left as of today. A considerable number have left, but in considering this question it is important to know where they go. For instance, we lost one dean of engineering to the University of Toronto. We have lost the head of the physics division in the University of Toronto, and in Queen's, and the head of the engineering division at McGill. We have lost two to professorships in the university. To industry we lost the biggest group, four went to Isotopes Products Limited. It is not a loss to the atomic energy field. Four young chaps went to form that company. Two others went to senior positions in industry, and there were two who went to government.

By Mr. Low:

Q. All within Canada?—A. Yes, and when you think of the very large organization it is more of a compliment than something to weep about.

Q. They are hardly losses to you?—A. They are not lost at all in the Canadian sense, and, in fact, in a real sense Isotopes Products is a gain to the overall picture in Canada. They are doing good work. The university people are really training men and some are acting as consultants. So, all in all, I would not think that our situation in that regard is more difficult than even the universities or government services. I think you will find that young people are naturally mobile. Young people do move around. I do not want to say we have no problems, but I do not think we could establish a particular problem more acute than exists in similar organizations in Canada today.

MR. GREEN: For instance, by comparison with the National Research Council, what is the situation?

THE WITNESS: My own feeling is that there is no difference at all.

By Mr. Gibson:

Q. Is this the first time in the atomic field that we have an opportunity to look at an atomic reactor after it has been working this long?—A. Yes, and it is the first time you will ever be able to look down into the centre. You will be able to look down on the top of the calandria which is down about 10 feet from the opening, and I think you will find it a very interesting experience because you will see how difficult the circumstances are under which we have to work with this new factor of radiation, which nobody has ever had to work with before. We are pioneering in that field of operating in the presence of this agency.

Q. You will be able to get some very interesting metallurgical ideas, I suppose?—A. A very great deal of interest. While one does not want to boast about accidents, I think we can feel that this is the type of thing which makes progress. We have got to have these experiences before we can detail and

new designs and deal with their operation. If we do put this pile back into operation, as we have every hope of doing—you will remember when the committee met last time I think I suggested that this was a declining asset and that it had an expectancy of perhaps five years and we could not do anything about it—in doing that we will really recover a five or 10 million dollar facility we were all prepared to write off. If you look at it in that way, if we can do this I think it is a great tribute to the ingenuity of those engaged in the operation.

Q. Have any of the carbon plants had any accidents of this kind, Doctor?—

A. We just do not know. That is a top secret. We do not know of the experiences that the Americans have had.

Mr. Low: I suppose you share freely, though, with the United States any information you gather from this experience?

The WITNESS: Oh, yes, we do, and we think it is a very useful thing to do, and they have been very cooperative and very helpful. Immediately this happened, I had a telephone message from Mr. Dean, Chairman of the Atomic Energy Commission of the United States, to the effect that anything that was in their power to do, they were anxious and willing to do it. They have been very helpful. The people who are actually operating those plants are operating under laws of the land which they have to obey, but personally they are very, very friendly and very anxious to cooperate in every way they can, and I think that we have been very fortunate and that our policy of giving information to them has paid off very handsomely. We will tell you, when we get up to Chalk River, some of the experiences which we don't want to make public now.

By Mr. Green:

Q. Have you made the Chalk River project available to students coming here from India and Pakistan under the Colombo Plan?—A. Well, we have to clear people. I mean, that is one of the important thing. We are under agreement to do that because we have other people's secrets. When we get people from distant lands, it takes an awful lot of time to clear them and it is almost impossible to clear on a casual basis. We have people from Great Britain, some from Australia, and we have people from other countries, but it is pretty difficult in certain countries to get the necessary clearances.

Q. You have to clear with the United States?—A. Oh, no, no.

By Mr. Coldwell:

Q. Security clearances?—A. You see, we have an agreement that we use each other's clearance systems, and it has been agreed that our security system is as good as theirs so that we do the clearing internally, but we agree on what we will clear for. For instance, people are to be given classified information and we agree that they must be cleared, but they are cleared according to the agencies in the countries we have agreed with.

Q. Have you students from India or Pakistan?—A. I do not think so. We have them in the National Research Council, though.

Q. You have not got them at Chalk River?—A. No, we have to limit the number of students we take there. We are not like the Research Council. We are a little more rigid in our programs than they are; we have definitely fixed programs of work and the students coming in there in the summer are there for training. We have another disadvantage in limited housing facilities, so we are not in the same position as the National Research Council is.

Mr. Low: Is there any special significance at all in the letter designations of those reactors? You have the NRU reactor and the NRX reactor.

The WITNESS: It is very difficult to get an exact answer to that. To me there is not, but probably somebody did conceive the word. We studied, before

we accepted this, about eight tentative code designations. They had to be given some code letters so that we could talk about them. I do not think there is much significance. I think NRX was a code name just for the purposes of hiding the meaning of it.

By Mr. Green:

Q. Are you still using your first reactor?—A. Yes, and it is very busy.

Q. That is the small one?—A. Yes, the small one. It is very busy.

Mr. COLDWELL: Does the so-called accident delay the production of the cobalt bomb?

The WITNESS: Yes, it will delay it, but it is like any manufacturing plant, you do not have a uniform production. You can store isotopes. You can build up a supply. And then when you shut down you are obviously going to feel that some day, but we propose when we start up again to give preference to the production of cobalt isotopes, so that we hope it is not going to be a very serious thing.

Mr. GREEN: When will the NRX reactor be back in operation?

The WITNESS: We have studiously refused to give that data on account of the pressure up there. We just say X months. We told them it had been down three months before. You see, the difficulty of an appointed date is that it is not in our hands. There are deliveries to consider, and as soon as you appoint a date it creates an embarrassment. However, it is a matter of months, and not weeks. Perhaps you will be able to get more information by talking to some of the people there, but I would not set a date. You can see the progress chart there, but I do not want to give any publicity to that. If I told the press that, they would put a date on the calendar and when that date came along they would want to know. I would be very glad to show you our estimates, provided you will realize we do not want to have people saying "you said you were going to do this". We know now that the time is not in our control because it depends on the delivery of equipment, which is beyond our control. That is a very interesting feature. We felt for a long time that the work we would have to do in a case like this would be the controlling factor, but the work is progressing very well indeed as far as we are concerned.

By Mr. Low:

Q. I suppose you have had to design a lot of equipment before it could be manufactured, did you not?—A. Well, we are putting the material back pretty much as it was, but we have to design equipment to do the tearing down.

Q. That is what I thought.—A. They are manufacturing that and that is the difficulty, and when we have to work slowly, deliberately, in the presence of this radiation. In some of these areas you can only work people perhaps an hour a day because you have a tolerance that you must not exceed, which is a safe tolerance as long as they live, and if they get their daily tolerance in 15 minutes you have to withdraw that man from these projects. We do an awful lot of preparation. If a man goes into an area where the radiation is high, then he is trained before he goes in there. He rushes in and he does his operation. He has his protection films on and they are read when he goes in and they are read when he comes out, so that he is under no danger at all. But that means a lot of staff work. If we did not have to worry about the health hazard, it would be quite a simple operation. The whole delay, the whole expense, is due in a major part to this health hazard. If you were not careful about your people's health, you could make very fast progress, but we cannot take any chances, at least we feel we do not take any chance at all.

Q. It is commendable that you are taking as great care as you are.—A. I think it is a unique precaution we are taking in the long term operation of the industry.

Mr. COLDWELL: It has paid off?

The WITNESS: It costs money, but I think everyone agrees we should not take chances, and we feel very definitely we are working under conditions that will be advantageous to the industry and we are refusing to take any risks whatever.

The CHAIRMAN: "Atomic Energy of Canada Limited." Any questions on that?

By Mr. Green:

Q. The NRU reactor is the new one?—A. Yes, that is the new one.

Q. When will it be completed?—A. That, again, is something that depends on how the construction proceeds—it also depends on materials from the United States. We would say, plus or minus, somewhere in the middle of 1955.

Q. That is another two years?—A. Yes. If we put NRX back in operation, you see we will not be so concerned about the early completion of NRU, it will not be so significant. We are not slowing it down but, again, if you hurry these things too much in design you are liable to pay for it. During the war all these reactors were built under a crash program, but as you go along in these very intricate projects, you are continually finding problems on which you want a little more information. You can compromise or you can do something you are not quite sure of, or you can delay it a bit. We feel we will not get some material from the United States before 1955, and I might say their programs are delayed also.

The CHAIRMAN: Are there any more questions?

By Mr. Green:

Q. But the cost is still expected to be about \$30 million?—A. Yes; well, that is the order of magnitude. We made our estimates in 1949 or something like that, and I am quite sure that it would not be under that. I feel quite sure that it will go over a certain amount because everything has gone up. The price level has gone up and the experience of everybody with these things is that it is the order of magnitude.

Q. You mean it will be quite a lot more than \$30 million?—A. I think it will be more than \$30 million, but I do not think it will be very much more. I am merely guessing, but I am saying that was everybody's experience of the last ten years. Consider that period of 1948 to 1949, with its increasing cost levels. You may estimate as of 1948 to 1949. Everybody at that time was thinking that the situation was going to peter off, and that there would be a lot freer competition. But with Korea prices have gone up as well as wage rates and all that, and it seems to me to be reasonable to expect an increase.

Q. You will have estimates as the work proceeds?—A. Yes.

Q. What is the estimate of the total cost now?—A. We have not got an exact estimate. We are going to get one within a short time. The difficulty is that you have to have development contracts and you cannot estimate until you get the final plans worked out. The plans and the control devices are not designed yet. As to the building, and the bricks and the stone, you can do that; but nobody likes to go out on a limb and estimate if he is going to be held to it, until he can see the thing clearing up. For instance, material is going up very rapidly. The price we pay for uranium is going up terrifically and we have no control over that.

Q. Who does have control over the price of uranium? Is it the United States?—A. Yes.

Mr. COLDWELL: You are entirely dependent on the United States as far as the price goes?

The WITNESS: Yes; and it in turn is a reflection of other prices. The Canadian price has gone up. When we went into it, do you remember what it was?

Mr. JARVIS (Secretary of the Atomic Energy Control Board): It started out at two seventy-five.

The WITNESS: And it is now?

Mr. JARVIS: The maximum is seven twenty-five.

By Mr. Low:

Q. Is the Canadian price parallel with that of the United States?—A. We do not know. The United States buy uranium all over the world. I do not know what the prices are. The prices are not uniform; they go according to the expense of getting it.

Q. Would Eldorado pay the producers in Canada the price which the United States would offer Eldorado?—A. They would be negotiated. That is the sort of thing that happens.

Q. Yes?—A. And we have not got any control over that.

Q. I see.—A. And the firms are tied up with war contracts and that makes your costs go up.

The CHAIRMAN: Are there any more questions on "NRU reactor"? Are there any questions in connection with "Atomic Energy of Canada Limited"?

Mr. Low: The minister of that department is the Minister of Trade and Commerce. Is that correct?

The CHAIRMAN: Atomic Energy of Canada Limited is responsible to the Atomic Energy Control Board, and it, in turn, is answerable to—what is the full name of that committee of the Privy Council?

The WITNESS: The Privy Council Committee on Scientific and Industrial Research.

The CHAIRMAN: And the chairman of that committee of the Privy Council is the Minister of Trade and Commerce.

Mr. Low: That is rather a complicated relationship?

The CHAIRMAN: So what it amounts to is that all the boards and crown companies concerned with this program are answerable to the Minister of Trade and Commerce with the exception of Eldorado, which is answerable to the Minister of Defence Production. I think that is the legal position.

Mr. Low: You must have a terrible time in getting together.

Mr. GREEN: I guess there is no doubt about who is the boss. Then Atomic Energy of Canada Limited is a Crown company. That is correct, is it not?

The CHAIRMAN: Yes, that is correct.

By Mr. Green:

Q. It is set up to carry on, or to direct the business activities in connection with atomic energy?—A. Of the Chalk River establishment.

Q. May we see the balance sheet for that company?—A. We could certainly show you the balance sheet that we took over, when the company took over from Atomic Energy Control Board, or National Research Council, in April 1952. We have a prepared balance sheet which you could see.

The CHAIRMAN: There is no objection that I can think of to your seeing the balance sheet, except that one year has yet to elapse.

Mr. GREEN: One year?

The WITNESS: You can see the starting balance sheet.

The CHAIRMAN: Yes, you can see the starting balance sheet and there will be no objection except that one year has not yet elapsed.

Mr. GREEN: What about the salaries; can we see them too?

The CHAIRMAN: I will see about that.

By Mr. Coldwell:

Q. If they are commensurate with the salaries paid in other government departments, they would not be at all terrifying, when compared with industry.

—A. Yes.

Q. They are relatively lower.

Mr. GREEN: How is the Board made up?

The CHAIRMAN: What is that again?

By Mr. Green:

Q. How is the Board of the Crown company made up? What was the set-up for the Board?—A. The Board has nine directors.

Q. They are listed on page 5?—A. Yes.

Mr. Low: Did you mean in your question: how did they select them?

By Mr. Green:

Q. Yes. How did they select them? What was the plan in setting up the Board?—A. They are really appointed by the stockholders, by the government of Canada.

Q. Which minister appoints them, the Minister of Trade and Commerce or the Minister of Defence Production?—A. It would be done by the Committee of the Privy Council.

Q. There appear to be power men on the Board.—A. That is right.

Q. And production men as well?—A. Yes.

Q. Just what was the plan in setting up the Board?—A. I cannot speak for the minister, but as I mentioned some time ago, it became obvious that if you are going to move into the power field, you want some one with power operating technique. That seems to be the way to open up all the technical facilities of Canada. For instance, when the Hydro Electric Development took place, it did not take place on the initiative of the men who manufacture electrical equipment. The initiative was in the operating people who, in turn, looked into the picture and then wrote specifications of what equipment they wanted; and then the manufacturers manufactured that equipment. That led to the opening up of the entire resources of the country. And it seemed that that was the reasonable way to do it.

We have power people, and the people who also have had a great deal of experience and initiative in the original power work. I cannot say that is the reason, but that certainly justifies the establishment of the Board.

We have Dr. Gordon who is a university man and who has had experience as a member of the National Research Council for many years, and who understands these different projects. Then we have Mr. Scully who has been Deputy Minister of Income Tax and is now comptroller of the Steel Company of Canada, Limited. He has knowledge of the set-up and the general accounting set-up. And we have in the scientific end along with Dr. Gordon, Mr. Birchard who, as vice-president of the National Research Council, understands its administration and the general set-up. I do not think this policy was ever laid down, but that is the way it seems to work out.

Q. You have no representatives from either the far west or the far east on the Board. Should there not be some representatives from those parts of the country?—A. Well, you have a very serious problem in getting these groups together quickly, and there is a terrific expense. You have people whose interests are pretty wide.

The CHAIRMAN: The major part of Mr. Bennett's operations are in the west and in the northwest.

Mr. GREEN: Mr. Bennett has farther to come than someone from British Columbia.

Mr. COLDWELL: Is it wise to consider representation on a geographic basis rather than on a basis of competence and efficiency? I suppose that is the reason?

The WITNESS: These people are all chosen on a personal basis, but we are trying to get a spread. For instance, Mr. Gaherty is president of the Calgary Power Limited, and is also president of the biggest power company in Nova Scotia; and he certainly does cover in his interests a very wide territory. I think the only argument you could put up is that British Columbia Electric is not in it. But we do more than this. We have adopted a policy of conferences with people who are interested, and it serves the same purpose of keeping in touch with developments. And we will take in British Columbia interests in that way.

By Mr. Green:

Q. Does this Board meet every week or ten days?—A. It has met that often. Sometimes once a month; but during the formative stage we met very frequently; and in cases of necessity, we would have group meetings. Our meetings would not be uniform like that over the year, but there might be times when we would have three or four meetings.

Q. In view of the fact that atomic energy would appear to be of more use to such areas as the Maritimes and Saskatchewan, in so far as power development is concerned, it would appear to be worth while to have more representatives on the Board directly from the Maritimes and also from British Columbia?

The CHAIRMAN: Would you knock out the general manager and the chief engineer of Hydro Electric of Ontario in order to give geographical representation to an area where you are going to use power? Is it not better to have representatives from areas where they have power developed than from areas which have not now got it? If you chose your representatives according to a geographic plan, you would be picking most of the men from areas where they have no power.

Mr. GREEN: I do not suggest that any should be taken off, but I do think the Board should be enlarged to take in some representatives from the Maritimes.

The CHAIRMAN: But would you not then get an unwieldly Board, just as was the experience of this Committee?

Mr. COLDWELL: It seems to me that the Board now is composed pretty much of power people, and if you appointed power men from British Columbia—

The CHAIRMAN: They would have a majority.

Mr. COLDWELL: Yes. You would have an overloaded Board, I would think.

The CHAIRMAN: Of the nine directors, four have power experience; and if you increase the number of power representatives, you then give the power representatives majority control of the Board. This would not be desirable with respect to the scientific and research end of such operations.

Mr. GREEN: What about the dean of engineering from Dalhousie, or somebody from there?

The CHAIRMAN: Does the dean of engineering from Dalhousie work on atomic energy in the University research work? The dean of the graduate school of engineering at Toronto does.

Mr. GREEN: This is too big a thing not to have all parts of the country actively tied in with it.

The CHAIRMAN: I think all parts of the country are actively represented in it now. For instance, take our chairman. His early history, I think, was in Saskatchewan. How do you identify any of those men with any part of the country?

Dr. GORDON: I do not know how you identify him with any part of the country. I do not know what part of the country we identify Mr. Scully with.

Mr. Low: I should think you would want the very best directors you could get, the men best qualified to do the work irrespective of their geographic qualification. We have one from Calgary.

The CHAIRMAN: Is he from Calgary? Do we charge him to Nova Scotia or Alberta?

Mr. Low: He gets his mail in Calgary anyway.

Mr. COLDWELL: I do not think the geographical situation should be over-riding.

Mr. GREEN: All I ask is that some thought be given to the subject.

The CHAIRMAN: What about "University Research"?

By Mr. Coldwell:

Q. Can you tell us something about that, Dr. Mackenzie?—A. The university research has not changed a great deal since the 1949 meeting. You remember that I indicated at that time that the policy of the Board was to support equipment or accelerators at the universities rather than place that equipment at Chalk River, and that we adopted the practice of accepting for any particular accelerator the first proposal put before us providing the university putting it before us was competent and could make proper use of it. We then supported the capital expenditure to roughly 50 per cent and under that category is the Van de Graff generator in British Columbia, the betatron in Saskatchewan, the synchrotron at Queen's and the cyclotron at McGill. There was the Cockcroft-Walton at the University of Montreal, and the chemical laboratory at McMaster. Then, after these were built we have supported them by annual grants according to their needs and the amount of work they were doing. We make an annual grant to these universities to help them operate these plants. That is a very useful arrangement. I think it is much less expensive than if we tried to put the whole thing at Chalk River and it also brings in the universities who are specialists in these fields and all the work they do is open to us. Generally speaking it is unclassified work, but it is very useful to us. We think it is a system that is highly commendable.

Q. Have you expanded it at all?—A. We have not expanded it since 1949.

By Mr. Low:

Q. Will this work continue under the Atomic Energy Control Board or under the National Research Council?—A. This is the Control Board, but we use the National Research Council's machinery. I should have mentioned that since the last meeting we have expanded these grants into two other fields. The metallurgical field was not covered in the other and the isotope development, which we are interested in expediting at the moment.

By Mr. Gibson:

Q. Do you actually get information from them valuable to you, or is it more a training school for young fellows you might use later?—A. Both. For instance, might I explain it this way. Radioactive isotopes, certain isotopes are made by putting in extra neutrons which we could put in the Chalk River pile. You can make isotopes by putting extra protons in as well which we cannot do in a pile but you can in an accelerator and with certain of the devices you get quantitative results which you cannot get with a pile. So all these are useful to fill in the technical information. At the same time they are training personnel.

By Mr. Green:

Q. Do we make use of the provincial research councils?—A. No.

Q. Are all universities in Canada participating in the plan?—A. No.

Q. Which ones?—A. Just these six.

Q. Which ones?—A. I mentioned the six, British Columbia, Saskatchewan, Queen's, McGill, Montreal, McMaster.

Q. The University of Toronto?—A. No. It would be a great mistake, if I may say so, for all the universities to concentrate in one field. There would be no sense in everybody allowing universities to go into the field because there are so many other activities and we would only support those universities which were in that field to start with and had special teams. For instance, Dr. Thode of McMaster University was an international authority and obviously it is an extension of his work; at McGill, Dr. Foster had his cyclotron plans drawn up in 1938 and he had been a nuclear physicist in good standing; at Queen's, Dr. Gray was a distinguished physicist and he had done a lot of nuclear work; and at Saskatchewan there is a very effective group. They have a combination of chemists and physicists and medical work and it is one of the really first class groups. We did not think it was our job to go in and say to the universities you should do this and that, and we also felt we could not afford to support more than one of these groups. We have one cyclotron in Canada at the moment and that is adequate.

Q. Would it not be helpful if the other universities were taking a part as well, both for the scientific end and the training?—A. It is not by any means the only scientific activity in Canada and it would be very wrong to take all the universities of the country and put them all on atomic energy. For instance, there are very broad fields that the University of Toronto is attacking, and other universities. Among them is the low-temperature field which is very important and they are getting help from the National Research Council. I think it is a pretty good picture speaking generally and I think most universities would agree. In the metallurgical field we are supporting metallurgical work at B.C. and Alberta, on the same basis.

The CHAIRMAN: Any more questions as to "University Research"? "Distribution of Isotopes".

By Mr. Gibson:

Q. Doctor, I see you sent some to Ann Arbor—this Cobalt 60 for the sterilization of foods. I was wondering how much repercussion it is going to have on the economic field if we could sterilize meat. Would it have any effect on closing butcher shops or things of that kind?—A. I would not think so. I think the main field would be to sterilize products which are sterilized in some other, more expensive way.

Q. You mean by heat?—A. By radiation—instead of boiling you do it by radiation. Our main interest is in the economics of production. If we could find out some mass use of those things it would be very satisfactory. This is

something a lot of people are interested in. And everything of that sort that was successful would mean that our project would be able to make material out of waste.

Q. Is it conceivable things might remain fresh and yet be sterilized?—A. I think that that is what you would have to aim at. If you deteriorated them, it would not be adequate.

Q. They would be packed, but you would not have to cook them, is that it?—A. I am speaking from general knowledge only, but that would be my feeling that you would be able to sterilize material from the outside and without boiling or whatever agency they put in. But I do think there are a number of fundamental problems to be attacked before it is solved. I understand some of the preliminary tests have changed the taste of certain things and if you change the taste or colour or odour it would be something that might not be acceptable. It is merely in the experimental stage, but it does interest people.

Q. It has tremendous economic possibilities I think?—A. Yes.

Mr. GREEN: You couldn't make an Atlantic salmon look like a Pacific coast salmon?

Q. What is the basis used in providing a cobalt bomb, who pays for it?—

A. It is a commercial proposition.

Q. You sell it?—A. We sell it. Before we became a company the commercial products division of Eldorado was the chief agency for our isotopes and they developed the application of the therapy unit and carried it on as a commercial proposition. We took that division over and it is carrying on as a commercial division.

By Mr. Gibson:

Q. How do you figure out the cost of getting a pound of cobalt 60?—

A. We are getting at the point where we do know or at least where we can appraise it. You see, if you can establish a price of plutonium then you can go one step further and establish the value of the neutron that made the plutonium. Now, cobalt 59 bombarded with neutrons makes cobalt 60. So, if you can place a value on the neutron, you can place a value on the cobalt 60. While it is not mathematical, it is getting to a point—at one time you could not price anything.

By Mr. Green:

Q. The hospitals have to pay you for the cobalt bombs?—A. Yes.

By Mr. Coldwell:

Q. How did they run across this?—A. It is merely a natural sequence from radiation. You treat people with radition and x-ray machines come in and do the same thing and when the piles came into operation it became obvious we could make cobalt 60 which had many advantages over radium or x-ray machines and we could get more in concentrated form and move it around to the patients. The whole thing is a very small physical unit and it is movable. Our project was interested in radioactive cobalt and the Eldorado Commercial Products Division conceived the idea of making the whole equipment; so did Saskatchewan. We provided a source to the University of Saskatchewan and they made the assembly.

Mr. COLDWELL: I saw it in operation and very effective it is indeed.

The WITNESS: Various people in parts of the world get interested in it. It is not a completely novel idea. It flows I think out of radium and x-ray machines. And it is possible something else someday will be found better than cobalt, but the fundamental thing is getting these high rays so you can treat the growth inside, the deep growth, without affecting the skin.

By Mr. Coldwell:

Q. It is more powerful than anything else?—A. It is per unit size.

By Mr. Green:

Q. What is the cost of a cobalt bomb?—A. You mean the whole assembly?

Q. Yes.—A. \$60,000 or something like that.

Q. How do you decide to which centers they will go?—A. It starts on a commercial basis. You start out and nobody wants them and then you get orders. It is not quite so simple as we have to modify our decision by the use it can be made of in safety, and we have an advisory committee of medical men to determine or advise us whether or not it is safe to ship any isotopes for clinical use. Obviously, when it is dangerous to humans we are not, as a civilian organization, going to take that responsibility and we have this advisory committee which is made up of a panel of first-class radiologists. There is one from B.C. I might say.

Mr. GREEN: Good.

The WITNESS: They might say to us, it is not safe to let one of these units go to hospital "Z" because there is no one there competent to handle it and it will be more dangerous to patients and they might also say you will only treat one patient there whereas in another center you could treat 1,000 a year.

By Mr. Coldwell:

Q. Is the apparatus designed on the same principle as the one at Saskatchewan? Was it designed there?—A. No, it was designed in the Eldorado.

Q. But they are all on the same principle, are they?—A. Yes, though they do not necessarily look alike, but what you have to do is to play this beam on various parts of the body and move the beam around like this. If they are treating a thyroid they want it to go in here and here and here and on all sides, so they can get a very intense radiation inside without hurting the skin. That means we have to get the machines going in three directions in rotation. It is not the same in all its physical configuration, but the actual ultimate purpose it the same.

Mr. COLDWELL: It is interesting to see a patient marked with little crosses on the body for this tiny, tiny ray.

The WITNESS: I saw two of them treated the other day and I was quite impressed.

(Discussion took place off the record.)

The CHAIRMAN: Any more questions?

By Mr. Green:

Q. Do you have much demand for the cobalt bomb?—A. Yes, there is quite an order list.

Q. More than you can supply?—A. Well, more than we could supply instantaneously. There is a very healthy situation in the relationship between what we can produce and the demand. An institution might have to build a building for the bomb and they might not want it for 18 months or two years.

Q. You mentioned using isotopes to tag fish the other day. Is that a practical application?—A. Yes.

Q. How do they do that?—A. —You have some of the food that the fish would take normally and you substitute or put in a radioactive atom in the compounds. They eat it just as an individual takes iodine. You could take iodine salt and put in a radioactive isotope, swallow it, and then follow it through the body with a geiger.

Q. Do isotopes lose their potency after a certain time?—A. Yes.

Mr. Low: That means some of us who are fishermen have to take a geiger counter?

The WITNESS: You just put the salt on the tail and catch the fish.

By Mr. Green:

Q. How about testing the fish with a geiger counter? What do you hope to find in one of these fellows who has been injected?—A. It would just merely identify the fish or identify his food source. We find some very interesting things on some of the theories on how the steps went from the very lowest forms of life up through the smaller plant forms, then to fish and then to humans and they found through isotopes that some of the radioactive material is blocked along the line. If you do not have bacteria the fish could not take it directly and it is a theoretical thing, but for the scientists it illuminates the step which is very interesting.

The CHAIRMAN: "Health precautions in connection with Radioisotopes". Any questions?

The WITNESS: May I interject a remark here. I think one of the interesting things is the growth in the use of isotopes. You remember at the previous committee sittings there was a lot of discussion about the lack of industrial use of isotopes. You will remember I said in commenting on it that the actual orders showed an indication of the interest and I listed about 47 to 49 examples of requests and inquiries we knew about at that time. This year the latest information is that—as against those in 1949 our shipments have gone up from 207 to 1,100 and the number of users has gone up from 20 or 30 to 102. In the States they have about 1,000 users and we have 100 to their 1,000, and that is very good, and I think they supply about 470 industrial organizations according to their last report, and we are supplying, we have somewhere around 40 to 50. So the picture is changing very much. I think we are safe in saying that the Canadian universities, Canadian hospitals and industries are making very full use of isotopes in comparison with other countries.

By Mr. Coldwell:

Q. What types of industries use isotopes?—A. It is pretty well spread all over the place and usually wherever there is any scientific laboratory you find users. We do not follow all these users because it is more or less on a commercial pattern and the Isotopes Products, this new company, purchase a lot of isotopes and then pass them into equipment and work with other commercial companies. We have a right to inquire and I suppose some of our technical officers know but we do not think it is the proper thing to do but generally speaking it is used in radiography.

Mr. Low: We saw a very interesting application of it down at the Massey-Harris plant where they were using it for the surface tempering of steel—just the surface alone.

The WITNESS: I feel personally that the picture has completely changed from what it looked like in 1949. There is participation in this which also means it is a going concern now and it is increasing every year.

Mr. GREEN: It is very encouraging.

The WITNESS: Yes, it is encouraging.

The CHAIRMAN: Page 7. Any questions on "Civil Defence"?

By Mr. Green:

Q. Is there anything extensive being done in that field?—A. We have nothing to do with civil defence. We merely provide them with any information they ask us about and we assist them, but we have no responsibility or connection with the actual work.

Q. You have had extensive experience as the result of the accident at Chalk River in the way to handle radioactivity? Are you taking any steps to spread that information to the civil defence organizations across the country?—A. We would not do it through the country. We would pass our information around to the headquarters whoever was responsible for doing it. I suppose they have been up to Chalk River—the Department of Defence has been there.

Mr. GREEN: That comes under the Department of National Health and Welfare. Civil Defence is under National Health and Welfare. I would think your experience there would be invaluable to civil defence organizations across the country.

The WITNESS: It is, but that will all be available to them. Our experts have gone through this. They would not individually be of much value to us there, because the people that we want at Chalk River, mechanics and pipe-fitters, people who come in and work, are the ones we look after, but undoubtedly this information will become available to them. I am sorry I cannot say definitely whether they have been up there. The army had decontamination teams there right after the accident, and they are in close touch with the situation all the time.

The CHAIRMAN: Any more questions on that point?

"International Relations"—we dealt with that earlier.

"Changes since 1949"—I think we dealt with that.

Now, "Production and Uses of Radioisotopes". Are there any questions on that?

By Mr. Murray:

Q. Is the Charles E. Frosst Company manufacturing isotopes for commercial use, or are they simply pioneering this field?—A. They take the isotopes from Chalk River and incorporate them into medicinal compounds, and the reason we have to use a pharmaceutical company is that the ultimate product has to be certified for human use. One can do work experimentally in a chemical laboratory with our products, but when the products are to be used for human consumption they must be sterilized, and so forth, and we must have behind us the certificate of a pharmaceutical company experienced in this type of work.

Q. Are they the only firm, Doctor, at the moment who are doing that?—A. They are the only firm. In 1948 we asked for bids from all of the pharmaceutical companies, on the advice of the medical people, who said we must have this available in Canada, and the Frosst tender was the best. Actually, most of the companies wanted money to do this and the Frosst Company said they would do it for nothing, which means they had to put up money; they had no profit in this for a number of years, but they did it on the basis that eventually it might be profitable.

The CHAIRMAN: Any more questions?

Mr. COLDWELL: I move we adjourn.

The CHAIRMAN: The meeting is adjourned.

The meeting adjourned.

